Bluetooth Security Hacking

The State of the Art

WiMe 2006

March 18th 2006, Coimbra, Portugal

by Adam Laurie, Marcel Holtmann and Martin Herfurt

... because infinite is sometimes not enough!

trifinite.org

Agenda

- Quick technology overview
- Security mechanisms
- Known vulnerabilities
- Toools & new stuff
- Demonstrations

Who is investigating

- Adam Laurie
  - CSO of The Bunker Secure Hosting Ltd.
  - DEFCON staff and organizer
  - Apache-SSL co-publisher
- Marcel Holtmann
  - Maintainer of the Linux Bluetooth stack
  - Red Hat Certified Examiner (RHCX)
- Martin Herfurt
  - Security researcher
  - Founder of *trifinite.org*

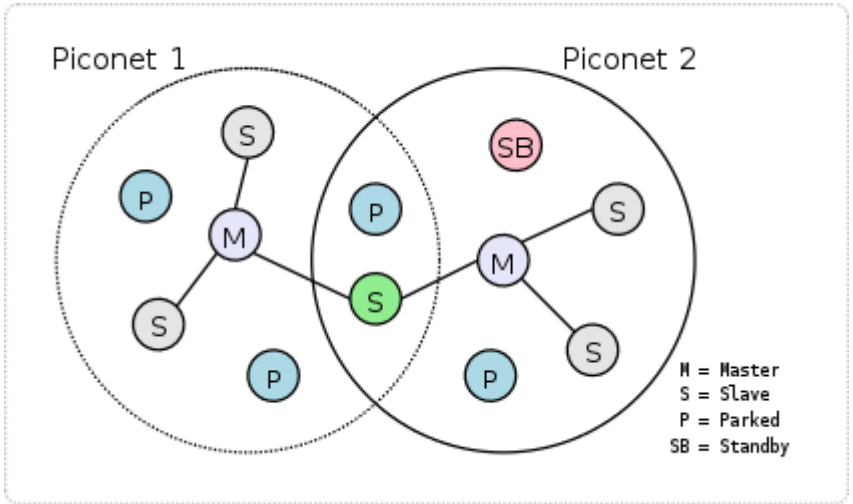
What we are up against

What is Bluetooth

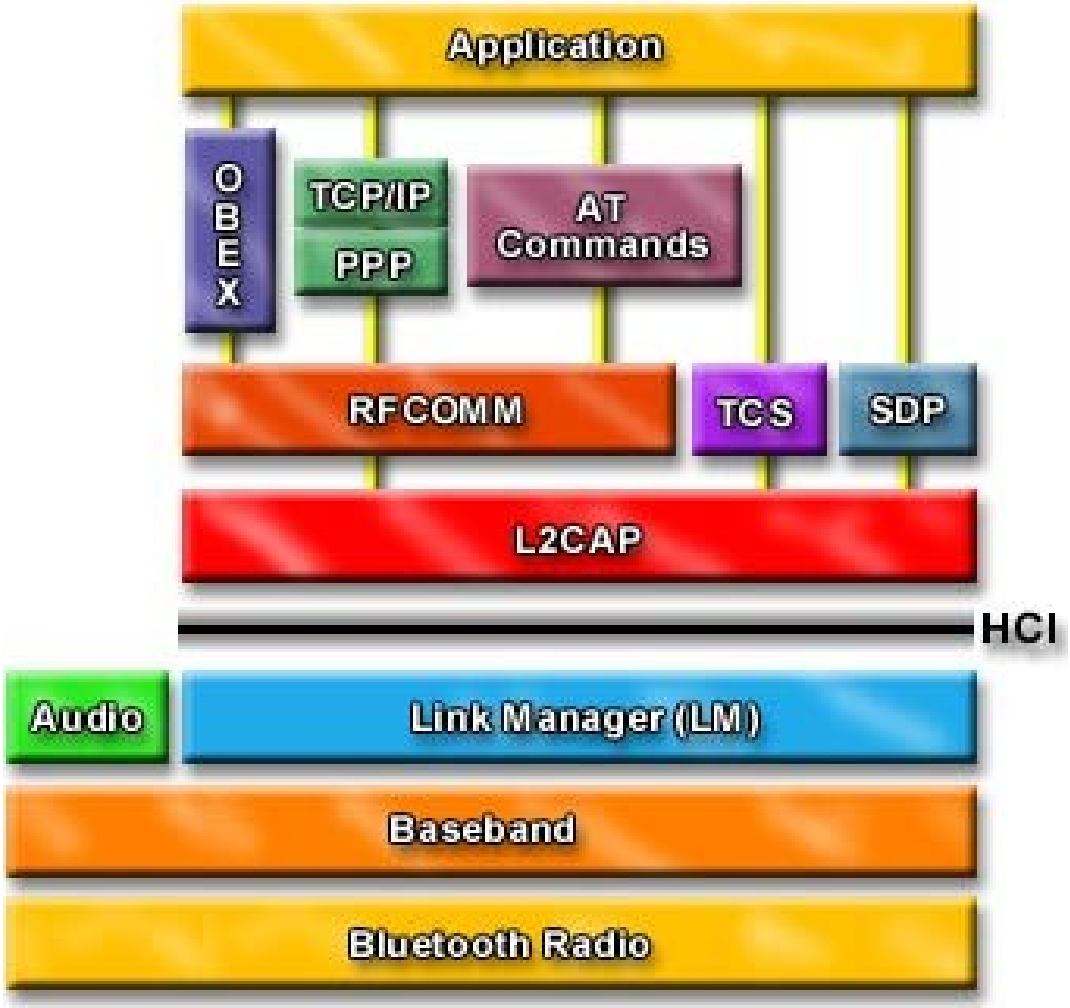
- Bluetooth SIG
  - Trade association
  - Founded 1998
  - Owns and licenses IP
- Bluetooth technology
  - A general cable replacement
  - Using the ISM band at 2.4 GHz
  - Protocol stack and application profiles

Network Topology

- Hopping sequence defines the piconet
  - Master defines the hopping sequence
    - 1600 hops per second on 79 channels
  - Up to seven active slaves
  - Scatternet creation



Bluetooth Stack



Application specific security mechanisms

Bluetooth host security mechanisms

Security mechanisms on the Bluetooth chip

Security modes

- Security mode 1
  - No active security enforcement
- Security mode 2
  - Service level security
  - On device level no difference to mode 1
- Security mode 3
  - Device level security
  - Enforce security for every low-level connection

How pairing works

- First connection
  (1) > HCI_Pin_Code_Request
  (2) < HCI_Pin_Code_Request_Reply
  (3) > HCI_Link_Key_Notification
- Further connections
  (1) > HCI_Link_Key_Request
  (2) < HCI_Link_Key_Request_Reply
  (3) > HCI_Link_Key_Notification (optional)

Principles of good Security (CESG/GCHQ)

- Confidentiality
  - Data kept private
- Integrity
  - Data has not been modified
- Availability
  - Data is available when needed
- Authentication
  - Identity of peer is proven
- Non-repudiation
  - Peer cannot deny transaction took place

Breaking all of them

- Confidentiality
  - Reading data
- Integrity
  - Modifying data
- Availability
  - Deleting data
- Authentication
  - Bypassed completely
- Non-repudiation
  - Little or no logging / no audit trails

Remember Paris

Compromised Content

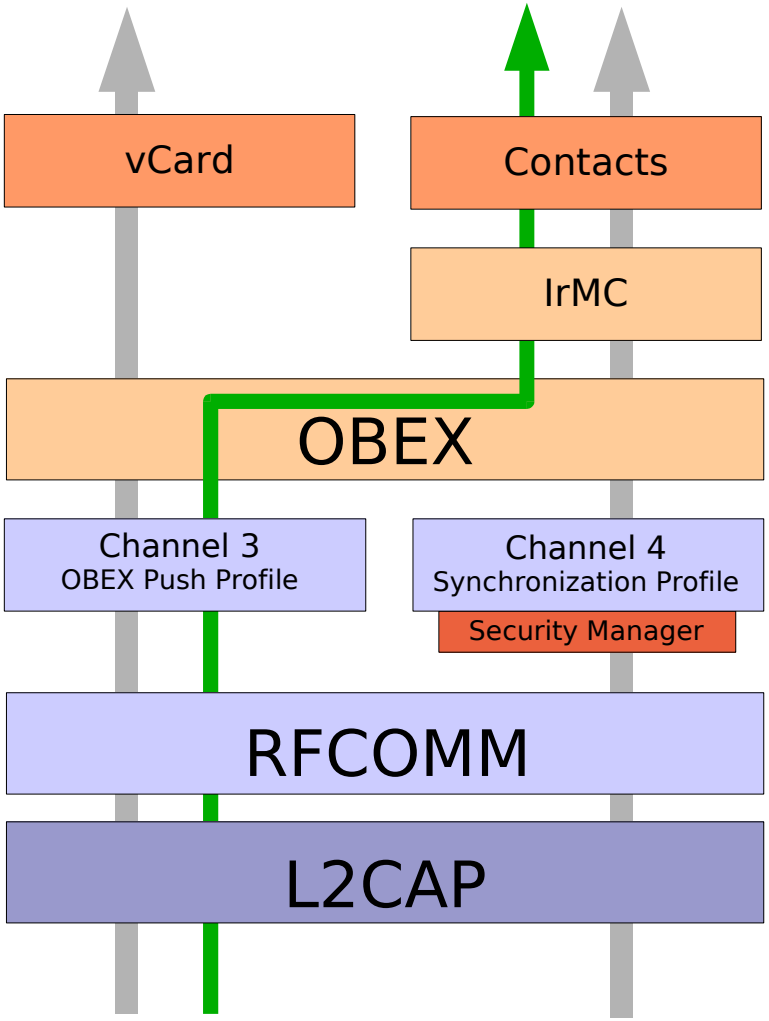
- Paris Hilton's phonebook
  - Numbers of **real** Celebrities (rockstars, actors ...)
- Images

- US Secret Service
  - Confidential documents

BlueSnarf

- Trivial OBEX push attack
  - Pull knows objects instead of pushing
  - No authentication
- Discovered by Marcel Holtmann
  - Published in October 2003
- Also discovered by Adam Laurie
  - Published in November 2003
  - Field tests at London Underground etc.

How to avoid pairing



HeloMoto

- Requires entry in “My Devices”
- Use OBEX push to create entry
  - No full OBEX exchange needed
- Connect to headset/handsfree channel
  - No authentication required
  - Full access with AT command
- Discovered by Adam Laurie

BlueBug

- Issuing AT commands
  - Use hidden and unprotected channels
  - Full control over the phone
- Discovered by Martin Herfurt
  - Motivation from the BlueSnarf attack
  - Public field test a CeBIT 2004
- Possibility to cause extra costs

Authentication abuse

- Create pairing
  - Authenticate for benign task
  - Force authentication
  - Use security mode 3 if needed
- Connect to unauthorized channels
  - Serial Port Profile
  - Dialup Networking
  - OBEX File Transfer

BlueSmack

- Using L2CAP echo feature
  - Signal channel request and response
  - L2CAP signal MTU is unknown
  - No open L2CAP channel needed
- Causing buffer overflows
- Denial of service attack

BlueStab

- Denial of service attack
  - Bluetooth device name is UTF-8 encoded
  - Friendly name with control characters
  - Crashes some phones
  - Can cause weird behaviors
  - Name caches can be very problematic
- Credits to Q-Nix and Collin R. Mulliner

BlueBump

- Forced re-keying
  - Authenticate for benign task (vCard exchange)
  - Force authentication
- Tell partner to delete pairing
  - Hold connection open
  - Request change of connection link key
- Connect to unauthorized channels

BlueSnarf++

- OBEX push channel attack, again
  - Connect with Sync, FTP or BIP target UUID
  - No authentication
  - Contents are browseable
  - Full read and write access
  - Access to external media storage
- Manufacturers have been informed

BlueSpooof

- Clone a trusted device
  - Device address
  - Service records
  - Emulate protocols and profiles
- Disable encryption
- Force re-pairing

BlueDump

- Yanic Shaked and Avishai Wool
  - http://www.eng.tau.ac.il/~yash/Bluetooth/
  - Expands PIN attack from Ollie Whitehouse
  - Requires special hardware or firmware
- Destroy trust relationship
  - Use the BlueSpooof methods
- User interaction for pairing still needed

BlueChop

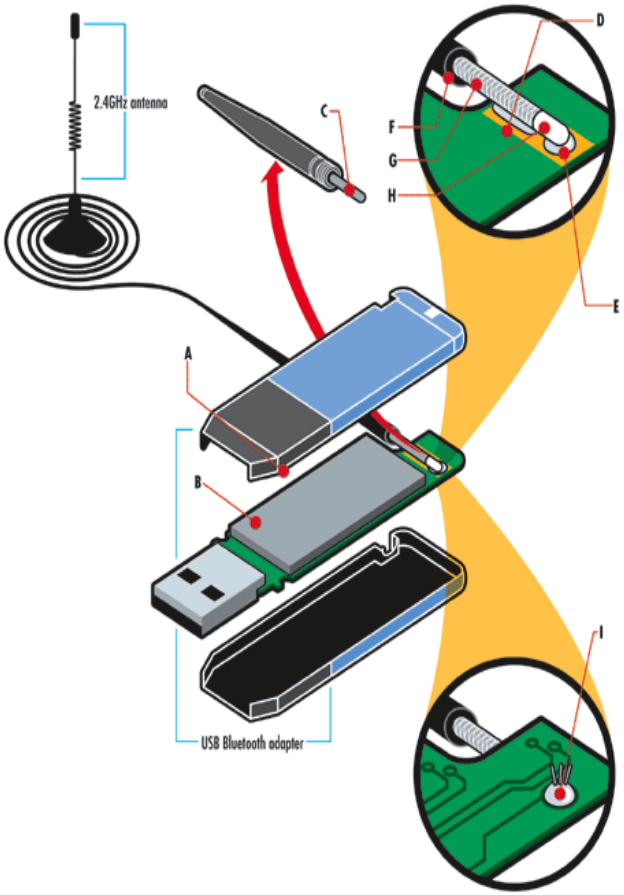
- Disrupts established Bluetooth piconets
- Works for devices that are
  - multiconnection capable
  - in page scan mode while connected

Blueprinting

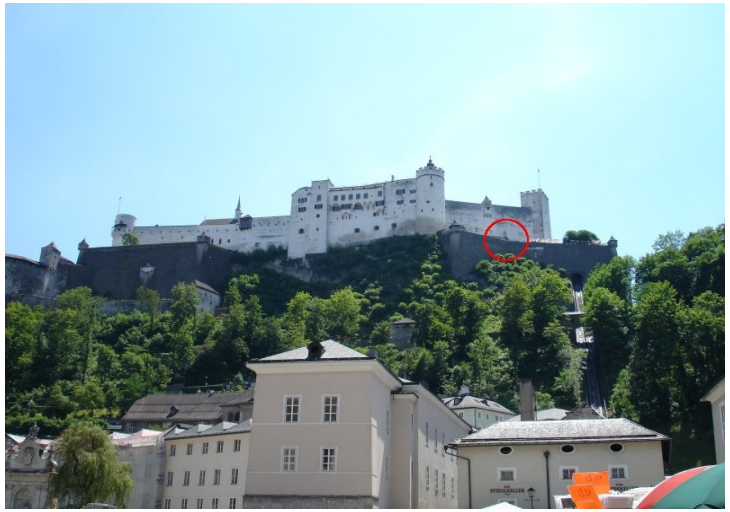
- Fingerprinting for Bluetooth
- Work started by Collin R. Mulliner and Martin Herfurt
- Based on the SDP records and OUI
- Important for security audits
- Paper with more information available

Bluetooone

- Enhancing the range of a Bluetooth dongle by connecting a directional antenna -> as done in the Long Distance Attack
- Original idea from Mike Outmesguine (Author of Book: “Wi-Fi Toys”)
- Step by Step instruction on trifinite.org



Bluetooone



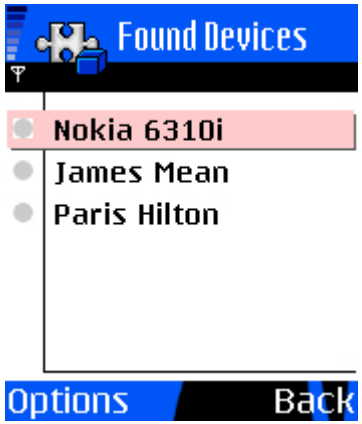
Blooover

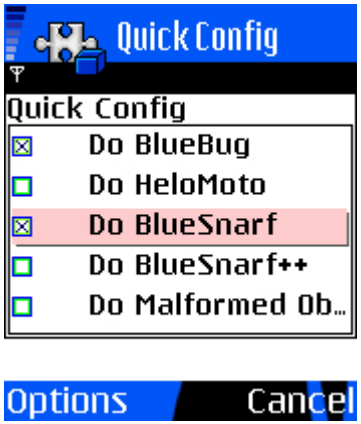
- Blooover - *Bluetooth* Wireless Technology Hoover
- Proof-of-Concept Application
- Educational Purposes only
- Java-based
  - J2ME MIDP 2.0 **with** BT-API
- Released last year at 21C3
- 150.000 + **x** downloads
  - Blooover also distributed by other portals

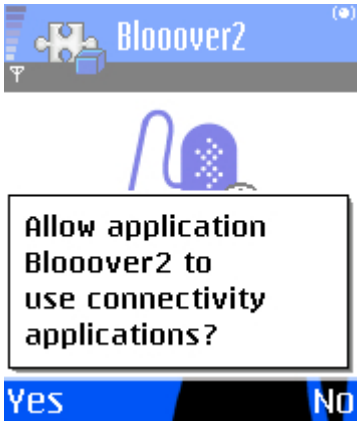
Blooover II

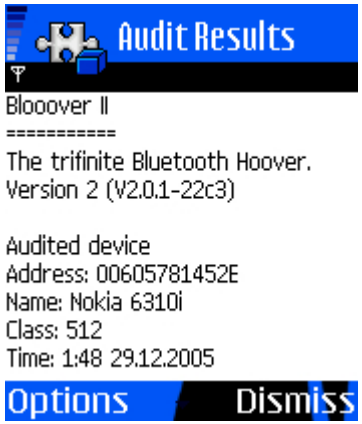
- Successor of the popular Blooover application
  - Auditing toool for professionals/researchers
  - Included Audits
    - BlueBug
    - HeloMoto
    - BlueSnarf
    - Malformed Objects
- Beta Version available now

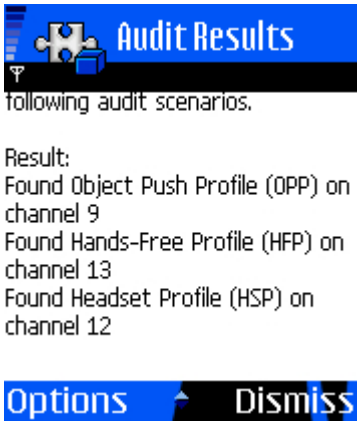
Blooover II - Auditing

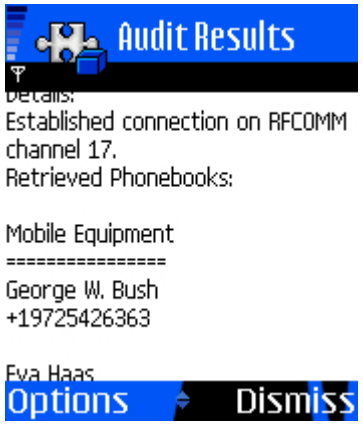




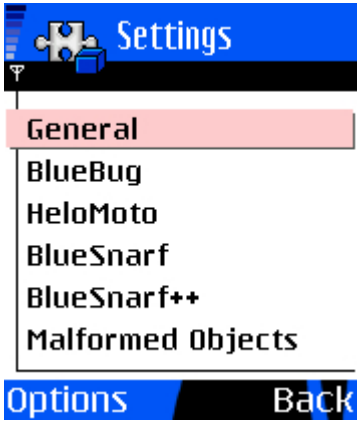


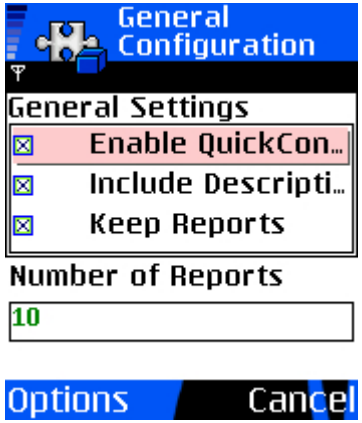


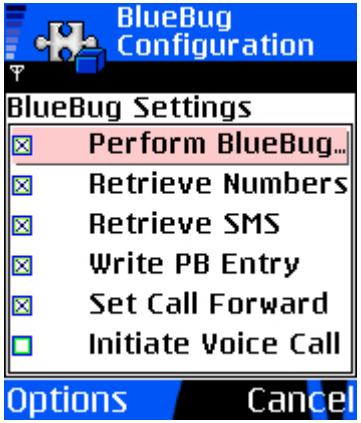


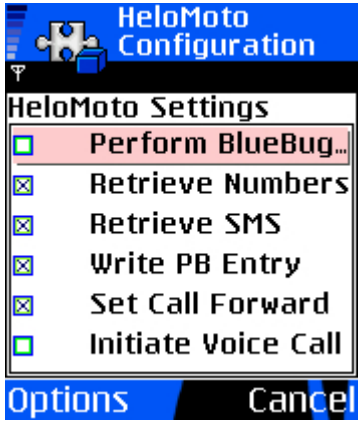


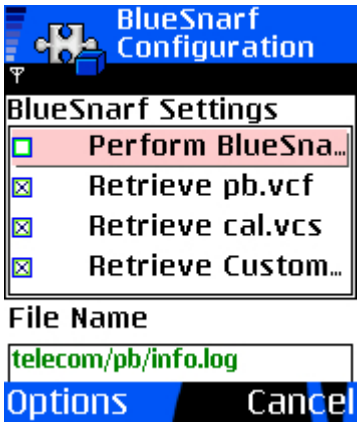
Blooover II - Settings

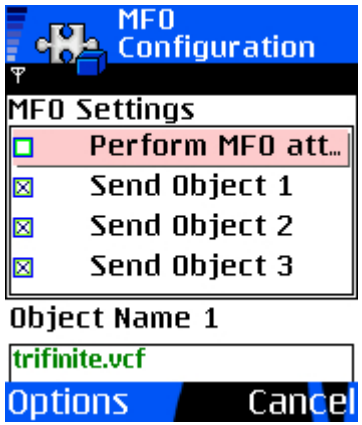


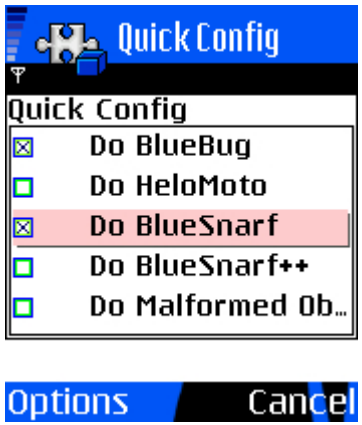












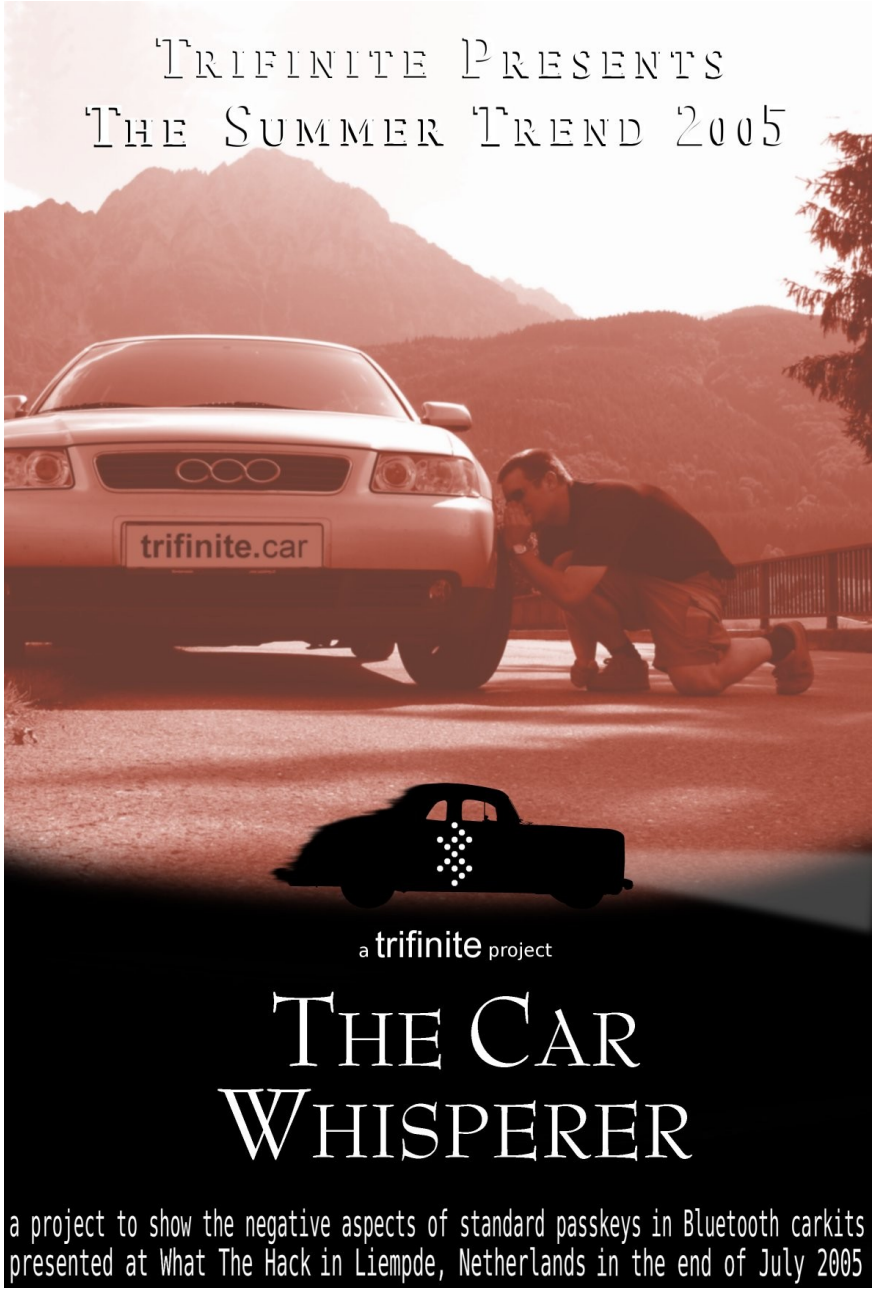
Blooover II - Breeeder

- World Domination through p2p propagation
- Breeeder Version distributes 'Blooover II Babies'
  - Babies cannot breed

The Car Whisperer

- Use default pin codes to connect to carkits
- Inject audio
- Record audio

- Version 0.2 now available
  - Better phone emulation capabilities

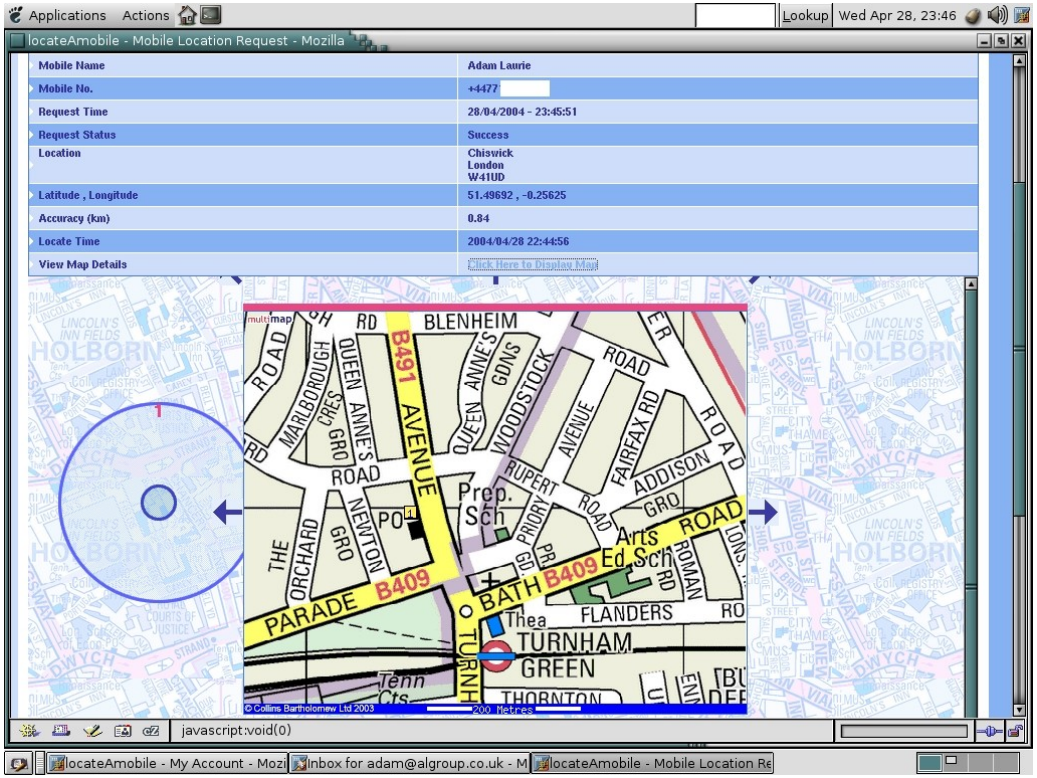


The Car Whisperer

- Stationary directional antenna
  - 15 seconds visibility at an average speed of 120 km/h and a range 500 m

BlueStalker

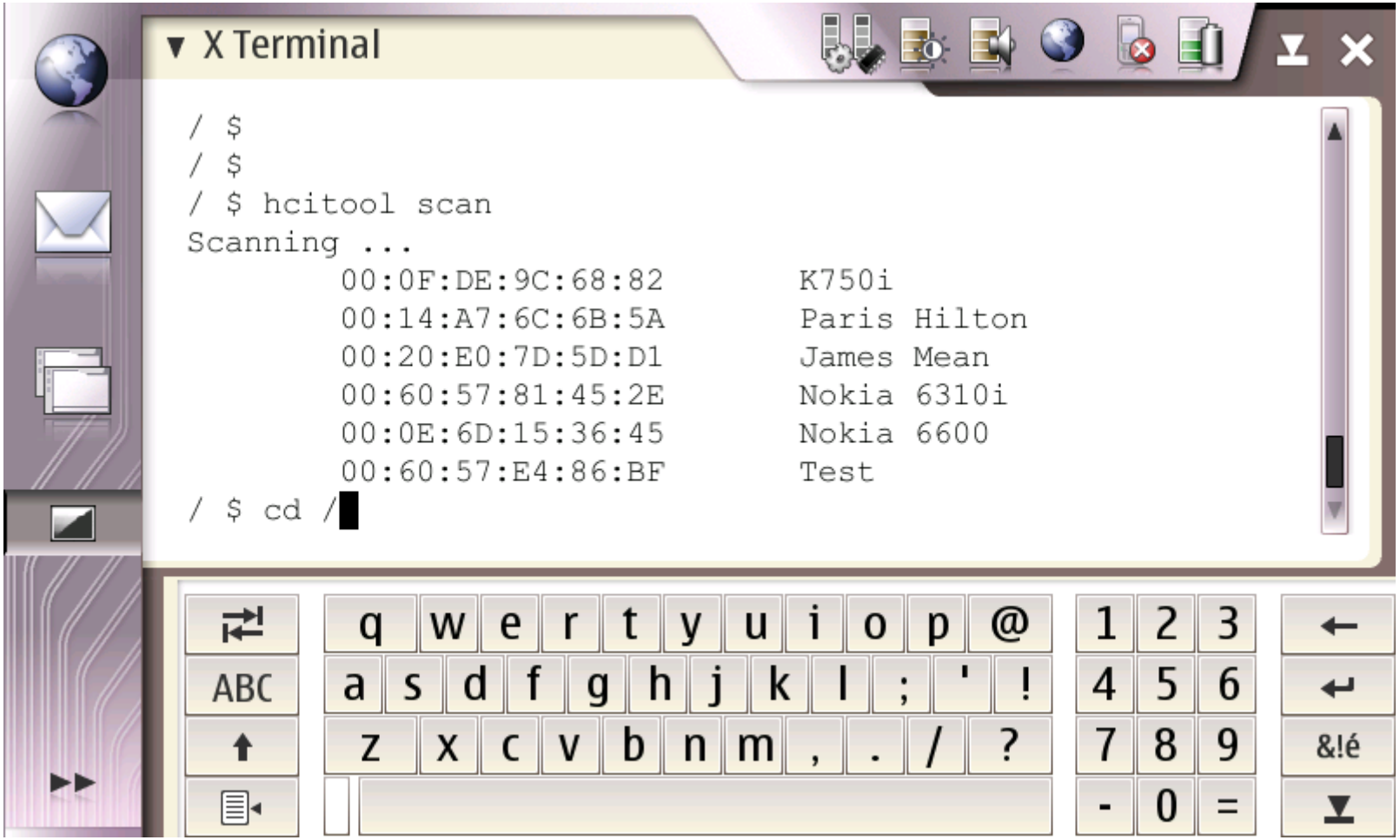
- Commercial tracking service
  - GSM Location tracking (Accurate to about 800 meters)
- BlueBug SMS message to determine phone number and intercept confirmation message



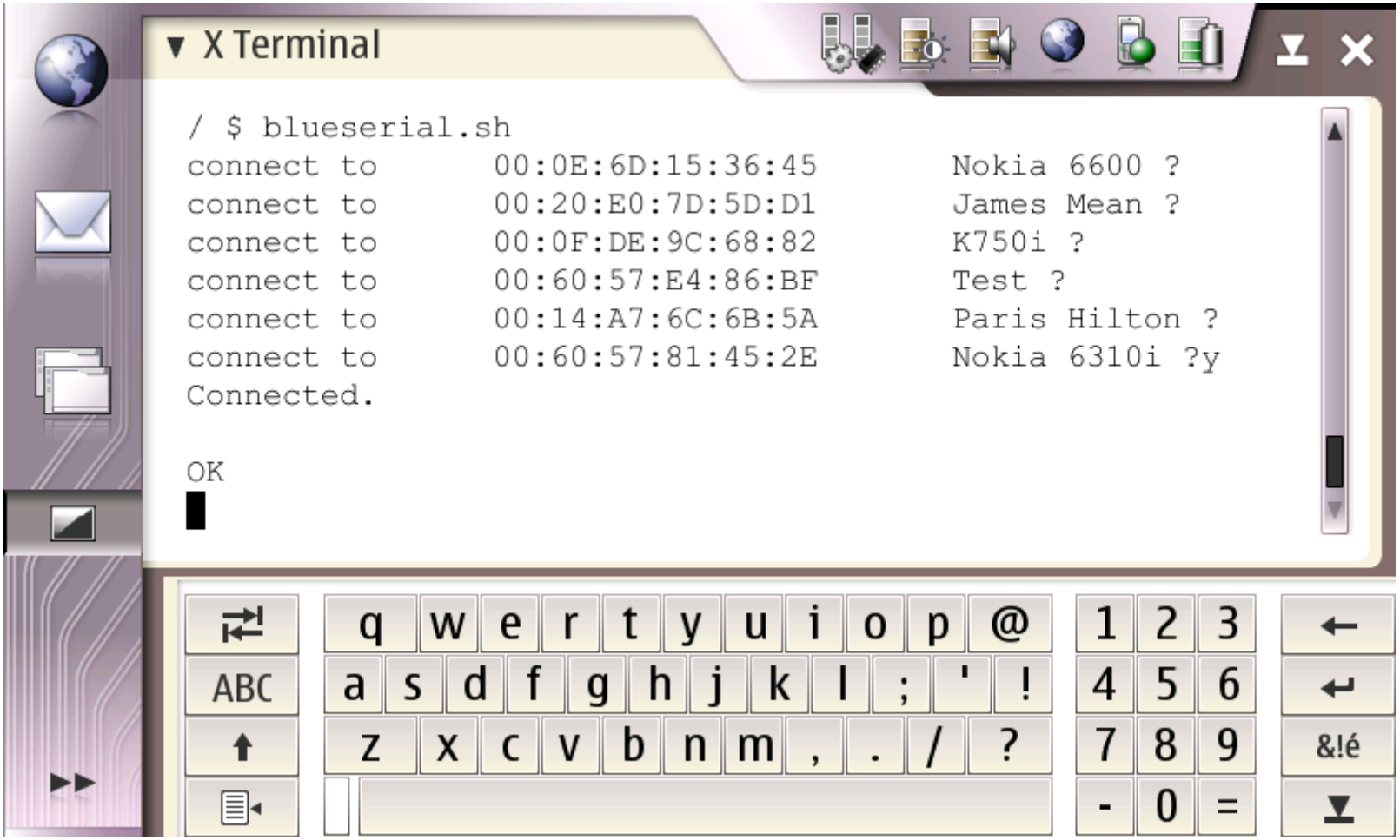
Nokia 770

- Tablet PC
- Supports
  - Wi-Fi
  - Bluetooth
  - **No** GSM/GRPS/UMTS
- Linux-based
  - Almost open source
- Details here
  - http://www.nokia.com/770
  - http://trifinite.org/trifinite_stuff_nokia_770.html

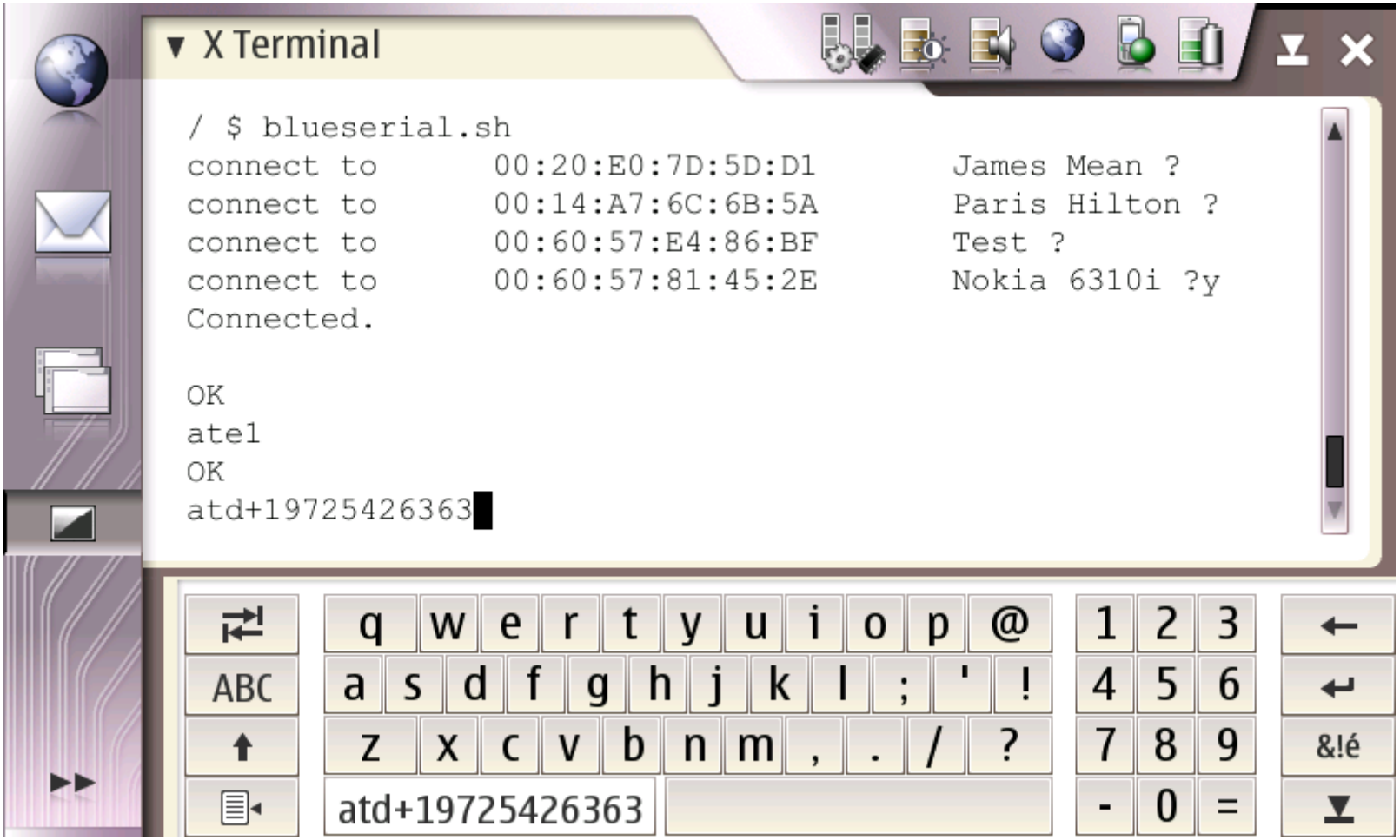
Nokia 770


X Terminal
/ $
/ $
/ $ hcitool scan
Scanning ...
00:0F:DE:9C:68:82 K750i
00:14:A7:6C:6B:5A Paris Hilton
00:20:E0:7D:5D:D1 James Mean
00:60:57:81:45:2E Nokia 6310i
00:0E:6D:15:36:45 Nokia 6600
00:60:57:E4:86:BF Test
/ $ cd /
ABC
&!é

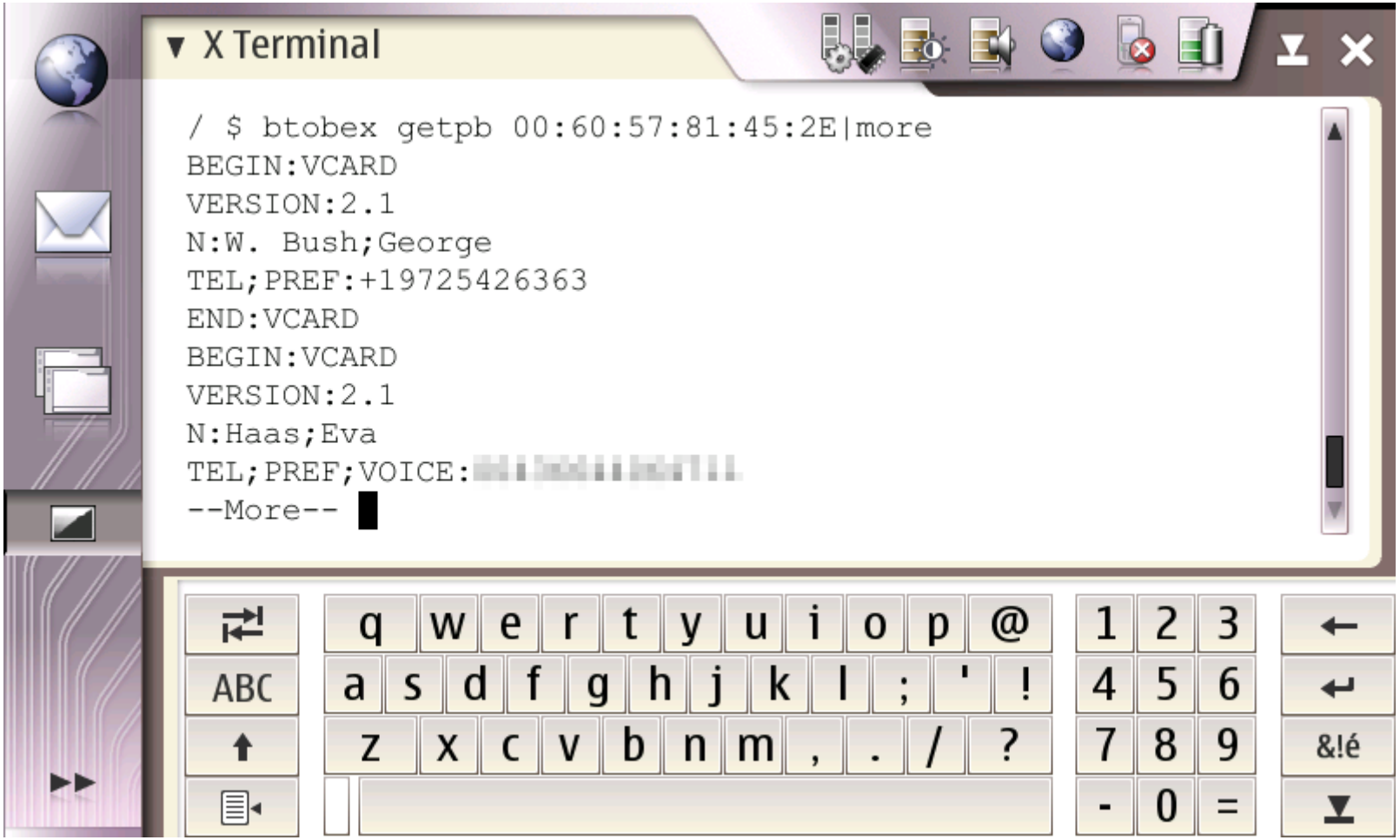
Nokia 770


X Terminal
/ $ blueserial.sh
connect to 00:0E:6D:15:36:45 Nokia 6600 ?
connect to 00:20:E0:7D:5D:D1 James Mean ?
connect to 00:0F:DE:9C:68:82 K750i ?
connect to 00:60:57:E4:86:BF Test ?
connect to 00:14:A7:6C:6B:5A Paris Hilton ?
connect to 00:60:57:81:45:2E Nokia 6310i ?y
Connected.
OK
ABC
&!é

Nokia 770


X Terminal
/ $ blueserial.sh
connect to 00:20:E0:7D:5D:D1 James Mean ?
connect to 00:14:A7:6C:6B:5A Paris Hilton ?
connect to 00:60:57:E4:86:BF Test ?
connect to 00:60:57:81:45:2E Nokia 6310i ?y
Connected.
OK
ate1
OK
atd+19725426363
ABC
atd+19725426363

Nokia 770


X Terminal
/ $ btobex getpb 00:60:57:81:45:2E|more
BEGIN:VCARD
VERSION:2.1
N:W. Bush;George
TEL;PREF:+19725426363
END:VCARD
BEGIN:VCARD
VERSION:2.1
N:Haas;Eva
TEL;PREF;VOICE:
--More--
ABC
&!é

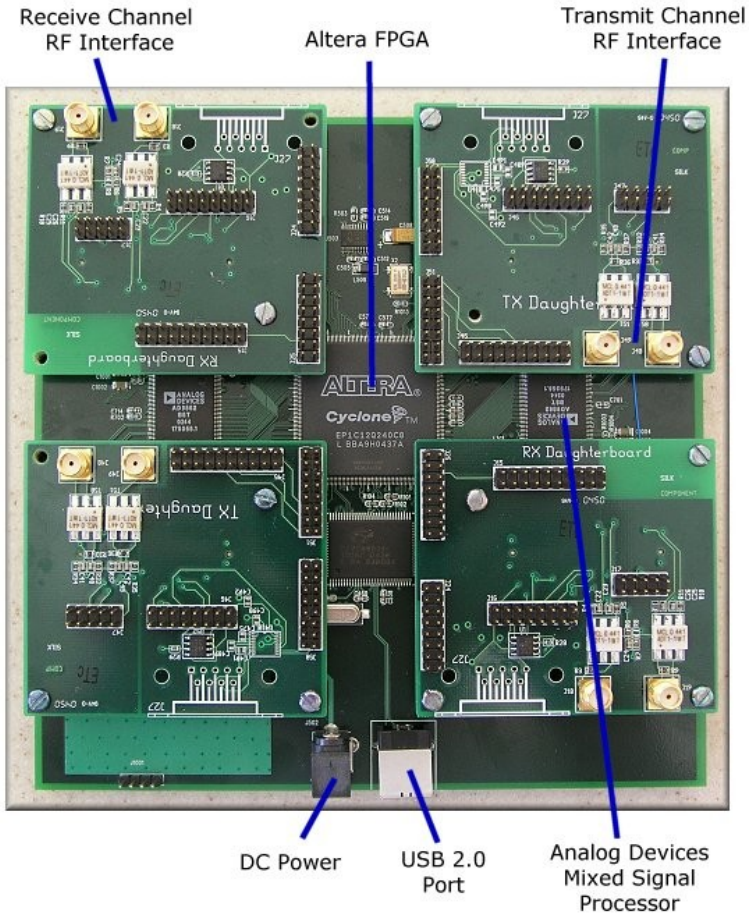
Blooonix

Bloonix

- Linux distribution for Bluetooth audits
  - Linux-based Live CD
  - Recent 2.6 kernel
  - Contains all latest BlueZ utilities

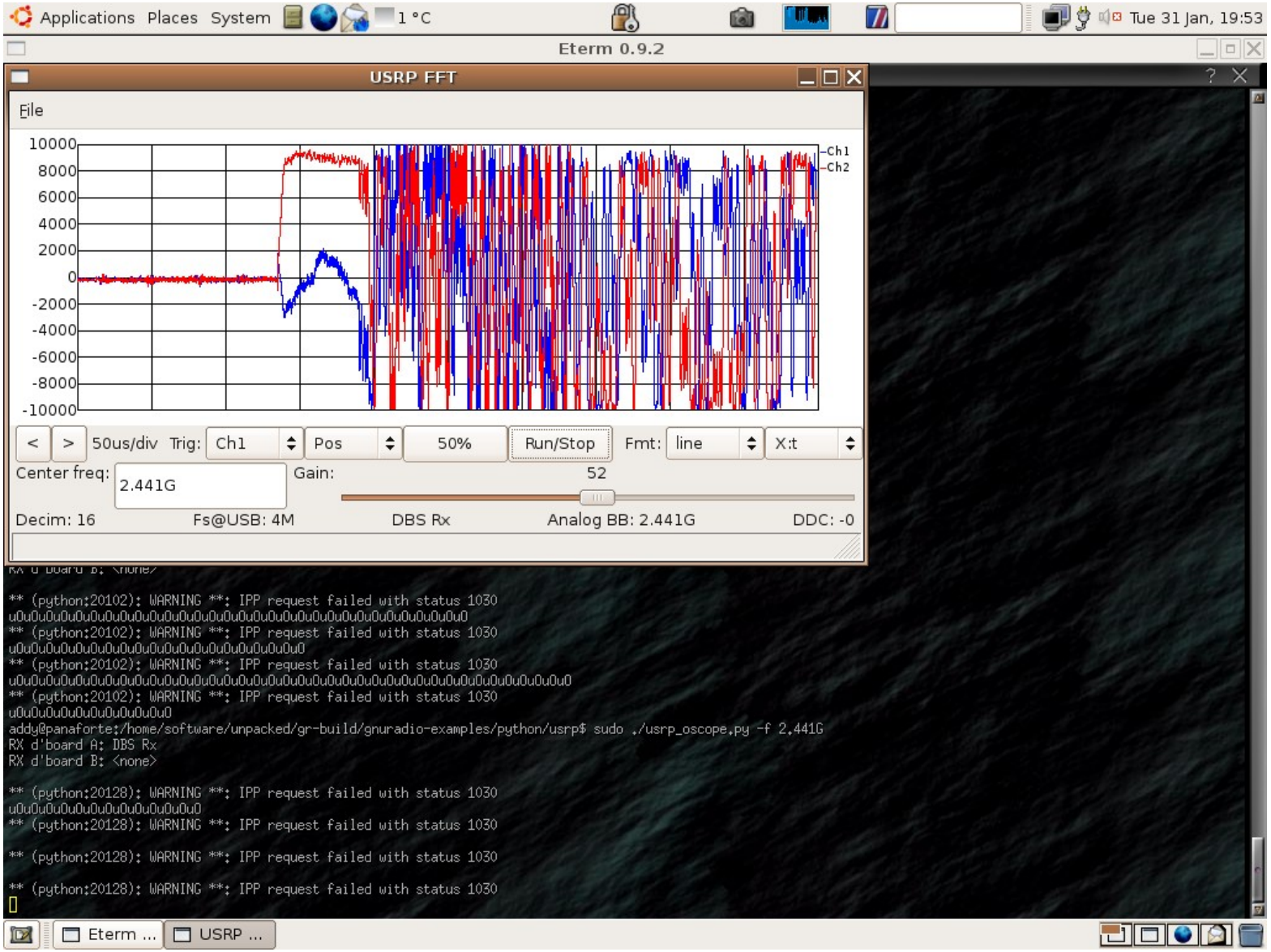
GNU Radio (1)

- GNU Software defined radio
- Universal Software Radio Peripheral hardware from Ettus



- http://www.gnu.org/software/gnuradio/
- http://www.ettus.com/

GNU Radio (2)


Applications Places System
1 °C
Tue 31 Jan, 19:53
Eterm 0.9.2
USRP FFT
File
10000
8000
6000
4000
2000
0
-2000
-4000
-6000
-8000
-10000
Ch1
Ch2
< > 50us/div Trig: Ch1 Pos 50% Run/Stop Fmt: line X:t
Center freq: 2.441G
Gain: 52
Decim: 16 Fs@USB: 4M DBS Rx Analog BB: 2.441G DDC: -0
** (python:20102): WARNING **: IPP request failed with status 1030
** (python:20102): WARNING **: IPP request failed with status 1030
** (python:20102): WARNING **: IPP request failed with status 1030
** (python:20102): WARNING **: IPP request failed with status 1030
addy@panaforte:/home/software/unpacked/gr-build/gnuradio-examples/python/usrp$ sudo ./usrp_oscope.py -f 2.441G
RX d'board A: DBS Rx
RX d'board B: <none>
** (python:20128): WARNING **: IPP request failed with status 1030
** (python:20128): WARNING **: IPP request failed with status 1030
** (python:20128): WARNING **: IPP request failed with status 1030
** (python:20128): WARNING **: IPP request failed with status 1030
Eterm ...
USRP ...

Bluetooth Sniffing

- Local Sniffing
  - hcidump
- Piconet Sniffing
  - special hardware or firmware
- Air Sniffing
  - Frontline (http://www.fte.com/)
  - LeCroy/CatC (http://www.lecroy.com/)

Conclusions

- Bluetooth is secure standard (per se)
  - Problems are at the application level
- Cooperation with the Bluetooth SIG
  - Pre-release testing at UPF (UnPlugFests)
  - Better communication channels
  - Clear user interface and interaction
  - Mandatory security at application level
  - Using a policy manager

trifinite.group

- Adam Laurie (the Bunker Secure Hosting)
- Marcel Holtmann (BlueZ)
- Collin Mulliner (mulliner.org)
- Tim Hurman (Pentest)
- Mark Rowe (Pentest)
- Martin Herfurt (trifinite.org)
- Kevin Finesterre (DigitalMunition)
- Joshua Wright (SANS)
- Spot (Sony)

Further information

- trifinite.org
  - Loose association of security experts
  - Public information about Bluetooth security
  - Individual testings and trainings
  - TRUST = trifinite unified security testing
- Contact us via contact@trifinite.org

The Next Big Challenge

Hacking TheToy - Just imagine all the girls freaking out when they sense the proximity of your geeky laptop ;)

Any questions?